

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte MASAHIKO YAMADA

Appeal 2007-1733
Application 09/978,275
Technology Center 2600

Decided: October 25, 2007

Before JOSEPH L. DIXON, JEAN R. HOMERE, and
MARC S. HOFF, *Administrative Patent Judges*.

HOMERE, *Administrative Patent Judge*.

DECISION ON APPEAL
STATEMENT OF THE CASE

Appellant appeals under 35 U.S.C. § 134 from the Examiner's final rejection of claims 1 through 13, 20, 21, and 37 through 41. We have jurisdiction under 35 U.S.C. § 6(b) to decide this appeal. We reverse.

The Invention

Appellant invented a method, apparatus, and computer-readable medium for suppressing noise in an input image signal representing a radiographic image by adapting the characteristic of a smoothing filter to the characteristic of the input image signal. (Specification 5, Title and Abstract.)

An understanding of the invention can be derived from exemplary independent claim 1, which reads as follows:

1. An apparatus for suppressing noise in an input image signal representing a radiographic image, comprising:

a smoothing unit which processes said input image signal by using a smoothing filter so as to smooth said radiographic image; and

a characteristic calculation unit which obtains at least one first characteristic of said input image signal by calculation using a function based on first information indicating an exposure dose with which said radiographic image has been produced;

said smoothing unit adapts at least one second characteristic of the smoothing filter to said input image signal based on said at least one first characteristic.

In rejecting the claims on appeal, the Examiner relies upon the following prior art:

Wood	US 5,351,305	Sep. 27, 1994
Vuylsteke	US 5,461,655	Oct. 24, 1995
Aach	US 6,173,084 B1	Jun. 9, 2001

The Examiner rejects the claims on appeal as follows:

- A. Claims 1 through 3, 7 through 13, 20, 21, and 37 through 41 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Vuylsteke.
- B. Claims 4 and 5 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Vuylsteke and Aach.
- C. Claim 6 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Vuylsteke and Wood.

Appellant contends¹ that Vuylsteke does not anticipate the invention as recited independent claim 1. Particularly, Appellant contends that Vuylsteke does not teach or suggest a characteristic calculation unit that obtains a characteristic of the input signal by using a function based on information indicating an exposure dose with which the radiographic image has been produced. (Br.18.) For these same reasons, Appellant contends

¹ In the examination of a patent application, the Examiner bears the initial burden of showing a *prima facie* case of unpatentability. *In re Piasecki*, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984). When that burden is met, the burden then shifts to the applicant to rebut. *Id.*; see also *In re Harris*, 409 F.3d 1339, 1343-44, 74 USPQ2d 1951, 1954-55 (Fed. Cir. 2005) (finding rebuttal evidence unpersuasive). If the applicant produces rebuttal evidence of adequate weight, the *prima facie* case of unpatentability is dissipated. *Piasecki*, 745 F.2d at 1472, 223 USPQ at 788. Thereafter, patentability is determined in view of the entire record. *Id.* However, Appellant has the burden on appeal to the Board to demonstrate error in the Examiner's position. See *In re Kahn*, 441 F.3d 977, 985-86, 78 USPQ2d 1329, 1335 (Fed. Cir. 2006) ("On appeal to the Board, an applicant can overcome a rejection [under § 103] by showing insufficient evidence of *prima facie* obviousness or by rebutting the *prima facie* case with evidence of secondary indicia of nonobviousness.") (quoting *In re Rouffet*, 149 F.3d 1350, 1355, 47 USPQ2d 1453, 1455 (Fed. Cir. 1998)).

that the combination of Vuylsteke and Aach or Wood does not render claims 4 through 6 unpatentable. In response, the Examiner contends that Vuylsteke's disclosure of decomposing a radiographic image signal into detail image pixel values teaches the claim limitation. (Answer 17.) Appellant further contends that Vuylsteke does not teach using pixel values including information indicating an exposure dose of a radiographic image signal to adapt a characteristic of the filter, as recited in independent claim 1. (Reply Br. 4.)

ISSUE

The *pivotal* issue in the appeal before us is as follows:
Has Appellant shown that the Examiner failed to establish that the disclosure of Vuylsteke anticipates the claimed invention under 35 U.S.C. § 102(b)?
Particularly, does Vuylsteke's disclosure anticipate the claimed invention given that Vuylsteke teaches decomposing a radiographic image into a sequence of detail images that are filtered according to a locally estimated amount of relevant signal and noise level present?

FINDINGS OF FACT

The following findings of fact are supported by a preponderance of the evidence.

The Invention

1. Appellant invented an apparatus (100) for suppressing quantization noise in low density areas of an input signal (S_{in}) corresponding to low-intensity exposure in a radiographic image. As depicted in Figure 1, the noise suppressing apparatus includes a band-

limited-image-signal generation unit (1), an index-value-obtaining unit (characteristic calculation unit) (2), a noise suppression processing unit (smoothing filter) (3), and an image reconstruction unit (4). (Specification 2, 3, and 27.)

2. The band-limited-image-signal generation unit (1) receives the input signal (S_{in}), and generates a plurality of band-limited image signals (B_k) by performing multi-resolution decomposition of the input image signal through Laplacian pyramid decomposition or wavelet transformation. (*Id.* 9 and 27.)

3. The smoothing filter (3) processes the band-limited signals and smoothes them out. (*Id.* 27.)

4. The characteristic calculation unit (2) obtains a pixel vector or a density vector at the pixel of interest in one of the plurality of band limited image signals, and detects an orientation of an edge as a noise characteristic of each of the plurality of band-limited images. Further, the characteristic calculation unit (2) obtains an index value indicating the degree of noise suppression for the signal based on information (e.g. menu of radiography, age of patient, radiography and normalization conditions) indicating the exposure dose with which the radiographic image has been produced. (*Id.* 7, 11, 27, and 28.)

5. Calculated noise suppression index values are utilized to adapt the smoothing filter (3) characteristics (mask size, center angle) to the values of the exposure dose with which the radiographic image was produced. (*Id.* 28 and 53).

The Prior Art Relied Upon

6. As depicted in Figures 3a and 4a, Vuylsteke teaches a noise reduction apparatus (3) having a circuit decomposition unit (30) that performs a pyramidal decomposition of a radiographic image by applying a transform to the image to yield a set of detail images (31) at multiple resolution levels and a residue (31'). Each detail image includes a set of transform coefficients expressing the relative contribution to the original image of the corresponding basis function out of a set of predetermined basis functions, each of the functions representing a local detail at a specific resolution level. The multi-resolution representation has a pyramidal structure such that the number of pixels in each detail image decreases at each coarser resolution level. (Col. 4, ll. 18-27; col. 7, ll. 8-13.)
7. As shown in Figures 3b and 5, Vuylsteke teaches that the detail images (31) are fed to pyramidal noise reduction unit (32) to pixel wise attenuate them as a function of a locally estimated amount of relevant signal content and in accordance with an estimated noise level. (Col. 7, ll. 24-32.)
8. In the Background of the Invention, Vuylsteke indicates that there exists a well-known tradeoff between diagnostic image quality and patient dose due to the presence of noise in the radiation source. (Col. 1, ll. 16-18.)
9. Further, Vuylsteke indicates that, ideally, filter parameters should be adjusted to the local image statistics. (Col. 1, ll. 29-30.)
10. Additionally, Vuylsteke indicates that adaptive noise suppression is known to have been achieved in the art by linearly combining all levels at

every pixel position, the weight coefficients being adapted to the local noise statistics at every pixel. (Col. 2, ll. 15-18.)

PRINCIPLES OF LAW

1. ANTICIPATION

It is axiomatic that anticipation of a claim under § 102 can be found only if the prior art reference discloses every element of the claim. *See In re King*, 801 F.2d 1324, 1326, 231 USPQ 136, 138 (Fed. Cir. 1986) and *Lindemann Maschinenfabrik GMBH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 1458, 221 USPQ 481, 485 (Fed. Cir. 1984).

In rejecting claims under 35 U.S.C. § 102, a single prior art reference that discloses, either expressly or inherently, each limitation of a claim invalidates that claim by anticipation. *Perricone v. Medicis Pharmaceutical Corp.*, 432 F.3d 1368, 1375-76, 77 USPQ2d 1321, 1325-26 (Fed. Cir. 2005), citing *Minn. Mining & Mfg. Co. v. Johnson & Johnson Orthopaedics, Inc.*, 976 F.2d 1559, 1565, 24 USPQ2d 1321, 1326 (Fed. Cir. 1992). Anticipation of a patent claim requires a finding that the claim at issue “reads on” a prior art reference. *Atlas Powder Co. v. IRECO, Inc.*, 190 F.3d 1342, 1346, 51 USPQ2d 1943, 1945 (Fed. Cir. 1999) (“In other words, if granting patent protection on the disputed claim would allow the patentee to exclude the public from practicing the prior art, then that claim is anticipated, regardless of whether it also covers subject matter not in the prior art.”) (citation omitted).

2. OBVIOUSNESS (Prima Facie)

The Supreme Court in *Graham v. John Deere Co.*, 383 U.S. 1, 17-18, 148 USPQ 459, 467 (1966), stated that the following factual inquiries underpin any determination of obviousness:

Under § 103, [1] the scope and content of the prior art are to be determined; [2] differences between the prior art and the claims at issue are to be ascertained; and [3] the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined. Such [4] secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy.

Where the claimed subject matter involves more than the simple substitution one known element for another or the mere application of a known technique to a piece of prior art ready for the improvement, a holding of obviousness must be based on “an apparent reason to combine the known elements in the fashion claimed.” *KSR Int’l v. Teleflex, Inc.*, 127 S. Ct. 1727, 1740-41, 82 USPQ2d 1385, 1396 (2007). That is, “there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *Id.*, 127 S. Ct. at 1741, 82 USPQ2d at 1396 (quoting *In re Kahn*, 441 F.3d 977, 988, 78 USPQ2d 1329, 1336 (Fed. Cir. 2006)). Such reasoning can be based on interrelated teachings of multiple patents, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art. *KSR*, 127 S. Ct. at 1740-41,

82 USPQ2d at 1396.

ANALYSIS

We begin our analysis by first noting that independent claims 1, 7, 8, 9, 10, 11, 20, and 21 all recite calculating a first characteristic of the input image signal using a function based on a first information indicating an exposure dose. (Br., Claim Appendix.) We find that Vuylsteke's disclosure reasonably teaches that limitation, as broadly claimed.

As detailed in the Findings of Fact section above, we have found that Vuylsteke teaches a radiographic image signal that, upon decomposition, yields a set of detail image values wherein each detail image includes a set of transform coefficients expressing the relative contribution to the original image of the corresponding basis function out of a set of predetermined basis functions, each of the functions representing local detail at a specific resolution level. (Finding 6.) We note that to produce each detail image, Vuylsteke iteratively uses a relative coefficient of the original image as well as a corresponding function based on the resolution of the original image. (Finding 7.) We further note that Vuylsteke's pyramidal decomposition captures the original signal in its entirety by preserving all the pixels with their respective resolutions, as well as a residual image. (*Id.*) In light of these findings, we agree with the Examiner that Vuylsteke's production of the detail images with their respective resolutions teaches the calculation of a characteristic of the image signal that is based upon an exposure dose with which the image had been produced.

Second, we note that the above independent claims also recite the smoothing unit adapting a second characteristic of the smoothing filter to the input image based on the first characteristic of the input image. (Br. Claim Appendix.) We find that Vuylsteke does not reasonably teach this limitation.

As detailed in the Findings of Fact section above, Vuylsteke teaches that each of the detail images is fed into the noise filter unit to iteratively attenuate them as a function of a locally estimated amount of relevant signal content and in accordance with an estimated noise level. (Finding 7.) We find that Vuylsteke's teaching is limited to filtering the detail images. Vuylsteke, however, does not explicitly teach using the detail images to adjust the filter by adapting a characteristic of the filter to a value of the calculated detail image.

It follows that the Examiner erred in rejecting independent claims 1, 7, 8, 9, 10, 11, 20, and 21 as being anticipated by Vuylsteke. We find for these same reasons that the Examiner erred in rejecting dependent claims 2, 3, 12, 13, and 37 through 41 as being anticipated by Vuylsteke.

35 U.S.C. § 103 Rejection

We now turn to the rejection of dependent claims 4 through 6 as being unpatentable over Vuylsteke, taken in combination with Aach, and/or Wood under 35 U.S.C. § 103. We find that the cited secondary references fail to cure the deficiencies of Vuylsteke noted above. For these reasons, we find

that the combination of Vuylsteke with the cited references does not render the cited claims unpatentable.

1 Rejection under 37 C.F.R. § 41.50(b)

We make the following new ground of rejection using our authority under 37 C.F.R. § 41.50(b). Claim 1 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Vuylsteke. As discussed above, we find that Vuylsteke does not particularly teach adapting the characteristic of the filter unit to a value of a detail image.² However, as set forth in the Findings of Fact section, Vuylsteke recognizes that adjusting filter parameters to the local image statistics is ideally known in the art for reducing noise in a radiographic image signal. (Findings 9 and 10.) Therefore, it would have been obvious to one of ordinary skill in the art to combine Vuylsteke's teachings with knowledge of the prior art to thereby adjust Vuylsteke's filter unit with the value of a detail image to adaptively adjust the filter unit. This combination would predictably result in a noise reduction system that fine-tunes the filter unit to reproduce images that matches the original signal as closely as possible. It has been held that "[t]he combination of familiar

² In the event, Appellant disagrees with our finding that Vuylsteke's production of detail images with corresponding resolutions teaches the calculation of a first characteristic of an image using information indicating an exposure dose with which the radiographic image had been produced, we find alternatively that Vuylsteke in combination with the knowledge in the prior art (Finding 8) teaches this limitation.

elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR.*, 127 S. Ct. at 1739, 82 USPQ2d at 1395 (2007) (citing *Graham*, 383 U.S. at 12).

OTHER ISSUES

The Board of Patent Appeals and Interferences is a review body, rather than a place of initial examination. We have rejected claim 1 above under 35 U.S.C. § 103(a) and under our authority in 37 C.F.R. § 41.50(b). We have, however, not reviewed claims 2 through 13, 20, 21, and 37 through 41 to the extent necessary to determine whether these claims are patentable over Vuylsteke. We leave it to the Examiner to determine the appropriateness of any further rejections based on this reference.

CONCLUSION OF LAW

On the record before us, the Examiner has failed to establish that Vuylsteke’s disclosure anticipates claims 1 through 3, 7 through 13, 20, 21, and 37 through 41 under 35 U.S.C. § 102(b). Further, the Examiner has failed to establish that Vuylsteke’s disclosure taken in combination with Aach and/or Wood renders claims 4 through 6 unpatentable under 35 U.S.C. § 103(a).

DECISION

In light of the foregoing, we reverse the Examiner's rejection of claims 1 through 13, 20, 21, and 37 through 41. However, we reject claim 1 under 35 U.S.C. § 103(a).

This decision contains a new ground of rejection pursuant to 37 C.F.R. § 41.50(b) (effective September 13, 2004, 69 Fed. Reg. 49960 (August 12, 2004), 1286 Off. Gaz. Pat. Office 21 (September 7, 2004)). 37 C.F.R. § 41.50(b) provides "[a] new ground of rejection pursuant to this paragraph shall not be considered final for judicial review."

37 C.F.R. § 41.50(b) also provides that the appellant, WITHIN TWO MONTHS FROM THE DATE OF THE DECISION, must exercise one of the following two options with respect to the new ground of rejection to avoid termination of the appeal as to the rejected claims:

(1) *Reopen prosecution*. Submit an appropriate amendment of the claims so rejected or new evidence relating to the claims so rejected, or both, and have the matter reconsidered by the examiner, in which event the proceeding will be remanded to the examiner. . . .

(2) *Request rehearing*. Request that the proceeding be reheard under § 41.52 by the Board upon the same record. . . .

REVERSED

ce/clj

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